FILE COPY FOREST INSECT LABORATORY UNIVERSITY OF CALIFORNIA BERKELEY, CALIFORNIA
625.3

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

FOREST INSECT INVESTIGATIONS

FOREST INSECT CONDITIONS

IN THE

CALIFORNIA REGION

A REVIEW OF THE 1937 SEASON

ANNUAL REPORT

BY THE

FOREST INSECT LABORATORY

BERKELEY, CALIFORNIA

MAY 1, 1938

TABLE OF CONTENTS

THE 1937 SITUATION IN BRIEF 1

HOW THE SURVEY ESTIMATES WERE OBTAINED 3

TOTAL ANNUAL LOSS FROM PINE BEETLES, CALIFORNIA REGION, 1925-1937 . . 4

THE PICTURE BY SUBREGIONS 5
Eastside - Northeastern California 5
Westside - Central California 6
Southern California 6

HOW RESULTS OF THE 1937 SURVEY HAVE BEEN USED 7

A FORECAST FOR 1938 8

DEVELOPMENTS IN FOREST INSECT RESEARCH DURING SEASON 10
Hazard Inventory of the Pine Areas 11
Determination of Tree Susceptibility and Salvage Experiments . . 12
Biology and Control of Economic Forest Insects of the Region . . 13

SUPPLEMENTAL AND STATISTICAL MATERIAL

Other Important Infestations of the 1937 Season 15
Pine Engraver Beetles 15
Fir Engraver 15
Fir Tussock Moth 16
Lodgepole Pine Needleminer 16
Great Basin Tent Caterpillar 16
Alder Leaf Beetle 17

Summary of Conditions in Eastside Pine Areas, Northeastern California, (Table) 18

Pine Losses in Northeastern California, 1925-1937, (Table) 19

Infestation Trends, Eastside Pine Areas, (Graph) 20

Selective Logging, Black's Mountain Experimental Forest. Summary of Progress 21

Forest Insect Hazard Inventory, Summary of Progress 22

Project Locations, Forest Insect Investigations and Surveys, California Region 23

Map 24

FOREST INSECT CONDITIONS IN THE CALIFORNIA REGION
A REVIEW OF THE 1937 SEASON

Annual Report by the Forest Insect Laboratory, Berkeley, California

THE 1937 SITUATION IN BRIEF

For the past twenty years the "pine beetle problem" has been recognized as the outstanding phase of the complex forest insect situation in the California region. Previous reports* have emphasized the devastating toll which these insects have taken from forest areas of high value. The records presented have also shown that the status of insect-caused losses fluctuates from year to year under the effect of uncontrollable natural factors as well as those which man can control. What, then, is the situation as it appeared at the close of the 1937 season when compared with that of past years?

The Bureau of Entomology and Plant Quarantine has completed the seasonal estimates of timber losses based upon surveys sampling the barkbeetle infestations in some seven million acres of pine type. These estimates make possible the following announcements.

"1. <u>The lowest estimate of pine losses since 1925 - a total of only 350 million board feet killed by beetles for the season.</u>"

This contrasts sharply with the total estimate of a billion and a half board feet killed by these insects in the same areas during the season of 1932. During the past five seasons the annual toll of

---

*Jan. 1932: Results and Recommendations, Forest Insect Survey, Region 5, for the Season of 1931. J. M. Miller and K. A. Salman.
*May, 1937: Regional Survey of Forest Insect Conditions, California Region, 1932-1936. K. A. Salman.

timber losses has declined steadily. The 1937 estimates are but thirty percent of those of 1932 - a decided change for the better. The factors responsible for this change have yet to be critically analyzed. Properly timed control work in some areas, the effects of natural factors alone in others, can be credited with this general improvement of conditions.

Of importance to conservation agencies however, is the question whether the low activity of beetle infestations reported for 1937 is no longer depleting the present forest capital. Was more timber destroyed than can be replaced by natural growth? On this point data compiled by the survey warrant the following statement.

> "2. On many areas we may expect that in the immediate future, growth will exceed the drain caused by insects; in other areas insects are still taking practically all or more than the natural gain essential to maintenance of the present volume of timber stands."

While the 1937 conditions present a far more favorable outlook for the lumbering industry than at any time in recent years, the threat of further depletion of the forests upon which this industry depends, has by no means been removed. From the long viewpoint, what can be expected in the way of continuation or further improvement of the present favorable situation? Here again, intensive studies based upon data of the survey, in selected areas, apparently warrant the following conclusion.

> "3. Many pine stands, particularly in northeastern California, remain highly susceptible to future barkbeetle attacks, and retain a nucleus of infestations capable of rebuilding serious epidemics. A slight shift in the natural factors may radically change the situation and bring on telling losses."

From these statements we may infer that, regardless of present conditions, the pine beetle problem has not been solved or eliminated,

and that there is need for the development of methods and plans for dealing constructively with outbreaks that may occur in the future. With this need in view, another statement bearing upon the favorable circumstances of the situation can be made.

"4. A program of research has been initiated and is now under way to determine the causes and to develop methods for the control of insect outbreaks of economic importance."

This program has been made possible by the resources recently made available to the Forest Insect Laboratory serving this region. Its plans and objectives will be discussed in a later section of this report.

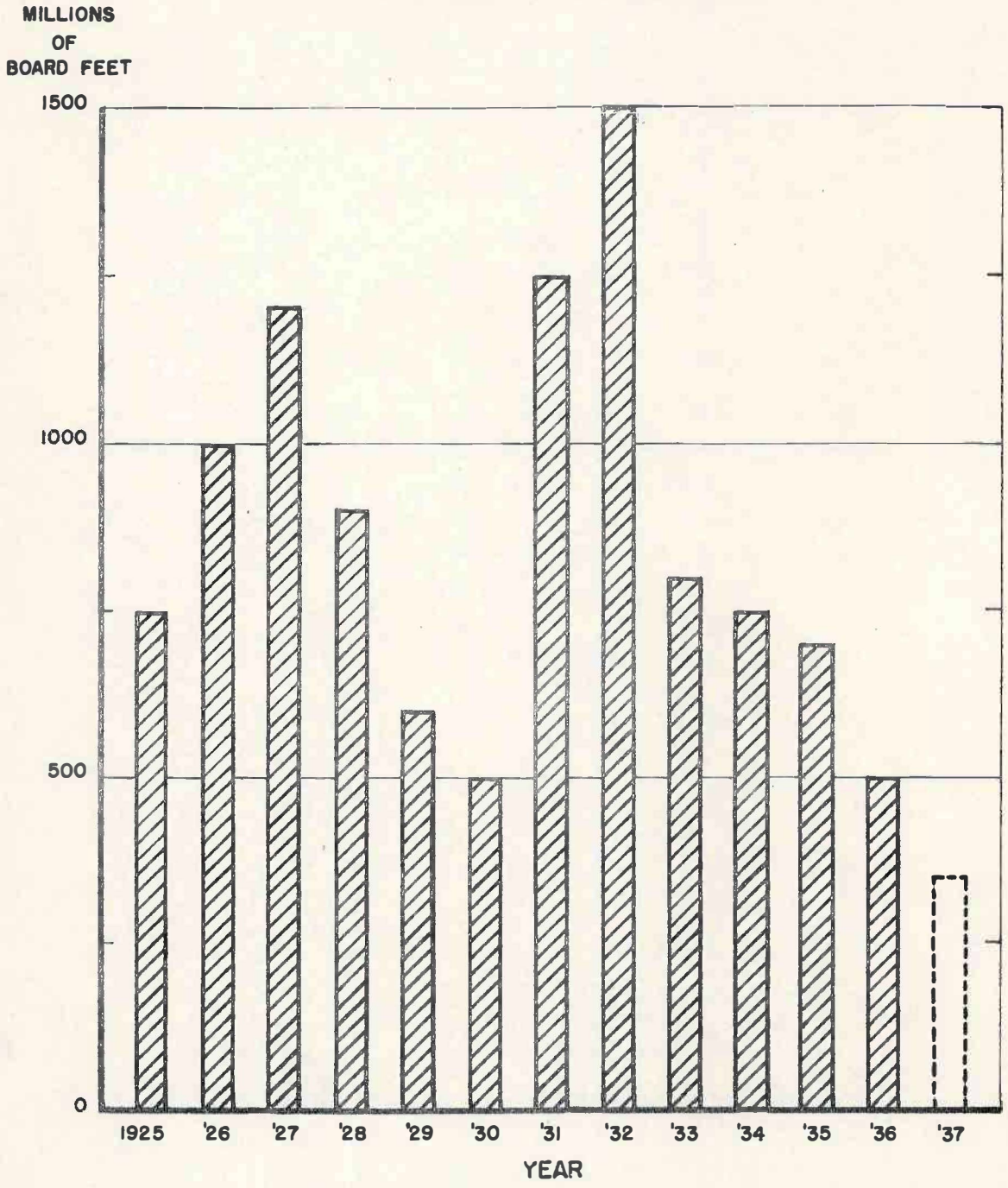
HOW THE SURVEY ESTIMATES WERE OBTAINED

Our estimates of the total annual insect-caused losses in pine timber are based upon the sample plot survey system maintained by the Bureau of Entomology and Plant Quarantine. At the present time this system gives only partial intensive coverage of the forest areas of the region. Permanent sample plots of about one half section each are intensively cruised each season to determine the amount of timber killed and the insect species responsible. These plot cruises form the basis for determining the average annual loss per acre, and this ratio is applied to the entire infested area for which the plot is representative. In addition, a visual reconnaissance is made of the main forest belts, and the final estimate is arrived at after conditions within the total area have been taken into account.

As shown in the annual report of May, 1937, the area sampled by intensive surveys includes 1,250,000 acres of the seven million acres of pine type in the region. This coverage includes practically

FIGURE 1

TOTAL ANNUAL LOSS FROM PINE BEETLES
CALIFORNIA REGION 1925-1937



all of the commercial pine belt of northeastern California and a considerable part of that along the western slopes of the Sierras. During the season of 1937, the survey system was extended to include an additional 250,000 acres mainly in the forest recreational areas of southern California. Our present region-wide estimates are based therefore, upon fairly intensive examinations of about one fifth of the total pine area of the region and upon scattered reports and observations for the remainder. No attempt has been made as yet to measure or estimate the total losses that are occurring in fir or other species of forest trees.

THE PICTURE BY SUBREGIONS

Because of the complex conditions of the region which include a wide range of climatic zones, forest types and a great variety of tree and insect species, the 1937 situation can best be described on the basis of the subregions outlined in the report of May, 1937.

Eastside - Northeastern California.

In the commercial pine stands of northeastern California a low point of losses was reached in most stands in 1937. For the subregion as a whole, the average annual loss did not exceed 70 board feet per acre, a loss still taking all or a large portion of the increment in most cases, but far below the peak losses of 350 board feet per acre reached in 1934. The loss estimates and other details of the conditions for each unit of the subregion will be found in the appendix material of this report.

This decline in losses correlates very closely with the subsidence of western pine beetle infestations. The 1937 attacks were restricted to scattered single trees, mainly those that had been weakened by the pine flathead. There were practically no group killings. Subzero cold in January, 1937, though largely local in its effects, had a part in bringing the population of this beetle down to the lowest level of the past ten years.

Pine flathead infestations continued at about the same level as in 1936, and were the major cause of losses in the Lassen and Modoc areas.

The work of incipient larvae was prevalent in many green trees which are slowly being weakened, and may provide the material for another outbreak of the western pine beetle when conditions become favorable.

Contrary to the general trend, the mountain pine and Jeffrey pine beetles were found to be on the increase although the resultant losses have not developed to serious proportions. An outbreak in lodgepole pine at Medicine Lake in Shasta County showed definite epidemic tendencies and immediate control work was recommended and was carried out with CCC labor.

Westside - Central California.

The pine belt along the western slopes of the Sierras draining into the Sacramento and San Joaquin valleys suffered light pine losses during the 1937 season. Here also the western pine beetle infestations were in the low endemic condition which has characterized the past few seasons. Some sporadic grouping attacks were noted, but these were so widely scattered that they may not indicate returning epidemic conditions.

The mountain pine beetle in sugar and lodgepole pine was on the increase in many local areas. Activities by this species pointed rather definitely toward an increasing trend, and for this reason control work has been recommended for several areas where the threatened values warranted it. During the summer season, control work on a cutover area in the Sierra National Forest under blister rust protection was carried on to protect reserve and seed trees; other projects were conducted by CCC labor in the mature sugar pine stands of the Yosemite and General Grant National Parks.

Southern California.

The forest type, climatic factors and uses in this subregion which includes the four southern National Forests of the region and the eastern slopes of the southern Sierra Nevada mountains, differ in many respects from the commercial pine areas of the other two subregions. The public use of Southern California recreational forest areas places a premium upon tree cover of all species, and has resulted in an insistent demand that such areas be kept as free as possible from insect-caused destruction. Local outbreaks have been combatted more or less continuously as they have developed. Because of this the play of natural factors has been restricted and trends have been more or less modified both by the intensive use of developed areas and the direct insect control measures which have been applied.

For the subregion as a whole, losses were light and influenced almost entirely by local factors. No definite subregional trends were indicated. The more important infestations during 1937 were caused by

the pine flathead. In the Lagunas district in San Diego County, a fairly aggressive infestation developed which was cleaned up by CCC labor under the Forest Service. Another infestation in the Idyllwild area of the San Jacinto which developed during the 1936 season was controlled during the winter of 1936-37 by a cooperative project including the Forest Service, State Forester and the Idyllwild community. Losses were reduced to the point where no further work was necessary during 1937. An active infestation of the Jeffrey pine beetle threatening the mature pines on intensively used summer home tracts developed during the season in the Big Bear district. Control measures were recommended for this area and were promptly undertaken by the Forest Service in December, 1937.

Up to the present year no continuous records of conditions have been available due to the lack of any comprehensive survey system. The Forest Insect Laboratory initiated such a survey in November, 1937, and set up a system of sample plots and check areas which will make possible continuous loss records and information regarding forest insect conditions. This survey will provide in the future, a much better basis for advice to the more important communities concerned as to needs for control work, and for the proper management of these areas to prevent serious depletion of the very limited forest cover.

HOW RESULTS OF THE 1937 SURVEY HAVE BEEN USED

The purpose of this survey is to secure not only a record of how much timber is being destroyed each year, but also to provide the basis for recommendations and plans to prevent or control forest insect infestations where such action is desirable. During the course of the season, 29 special reports were prepared dealing with conditions in areas covering approximately 1,500,000 acres, representing values running into millions of dollars. These reports together with appropriate recommendations were made available to some 200 individuals and organizations concerned with protection of the forest resources on these lands.

Direct control work was recommended and methods suggested for 9 of the areas included: on the Eastside ponderosa pine stands, salvage or management plans were recommended for about 700,000 acres,

including both Forest Service and private timber holdings in the Modoc, Lassen and Plumas National Forests, while in the remainder of the areas covered, no immediate action was recommended because of current favorable conditions due to natural factors of control.

One of the chief benefits of the survey record, however, is its application to research in the study of trends. This material is not only being utilized by the Berkeley Laboratory, but has also been made available to cooperators concerned with the research phases of the problem.

A FORECAST FOR 1938

To be forewarned of an impending barkbeetle epidemic is often as important to those concerned as a knowledge of what measures to take after the outbreak has developed. Early utilization of the trees on threatened areas or prompt action to control the first "hot spots" of a rising infestation may prevent the waste of a vast amount of forest capital. On the other hand, a knowledge that the peak of an epidemic has been reached and a decline is due, can be used to avoid much useless effort on control work. Will the present low point of the infestation cycle continue, and for how long? This is a question of more than academic interest.

An unqualified answer to the above question is highly hazardous , as many factors are involved, the cause and effect of which cannot be predicted with assurance. With our present knowledge of the behavior of barkbeetle infestations, long range forecasts are no more feasible than are weather predictions extending beyond the influence of the immediate controlling factors which can be appraised. However, recent

biological studies have developed some basis for short term tentative predictions of infestation trends that can be expected for the season immediately ahead in the eastside ponderosa pine stands. This is possible because of a better knowledge of the association of bark-beetle species which compose infestations characteristic of the California region. It was found that the relation of the activities of the species composing current barkbeetle populations and the timing of their attacks, give a clue to the status of the infestation cycle. On this basis, the decline of infestations which began in northern California during the season of 1935 was suspected. Putting the theory to a test, entomologists in the fall of 1936 made definite predictions as to 1937 trends for selected areas. These were shown to be reasonably accurate by subsequent developments.

Looking at the region as a whole, any predictions as to conditions for 1938 would be subject to many local exceptions and therefore are of doubtful value. The conditions found in most areas at the close of the 1937 season do, however, warrant an optimistic outlook.

In the eastside conditions, predictions have already been made for the 1938 season in special reports submitted for the Modoc and Lassen forests. These are:

1. Insect-caused losses probably will remain fairly low. Due to the highly susceptible condition of many fringe stands, it is probable that losses may increase towards the end of the season in such areas.

2. The infested trees will be chiefly those succumbing to a combination or succession of attacks by several species. The California flatheaded borer will remain a menace. The western pine beetle should consolidate its position in the infestation during the season and show further recuperation from the present low population level resulting from natural trends and the effects of the abnormal low temperatures of January, 1937.

3. It is expected that mountain pine beetle infestations in ponderosa and lodgepole pine and Jeffrey pine beetle in Jeffrey pine will continue to increase. However, that should not have a great effect on the total loss figure for three needle pines. In lodgepole pine recreational areas, it is expected the mountain pine beetle may be a threat to the stands.

The accuracy and assurance with which predictions of this character can be made will depend upon the success of further development of certain phases of the research program of the region. It is this program that we will now consider.

DEVELOPMENTS IN FOREST INSECT RESEARCH DURING THE SEASON

The justification for an enlarged research program within the region lies in developments that have taken place during the past twelve years. The destruction of ten billion board feet of valuable timber has impressed conservation agencies with both the seriousness and the long range character of the problem. It has been shown that recurrent conditions such as those which developed during this period will nullify the best plans that can be made for the intelligent use and conservation of California's forest resources. As long as insects can, as they have during the past decade, determine the ultimate supply of timber which will be taken from the forest, sustained yield practices essential to the supply of permanent forest industries are impracticable. Equally important to thousands of pleasure seeking vacationists who annually visit California's parks and recreational areas is the maintenance of suitable forest cover, free from destructive insect infestation.

The basis for a satisfactory answer to the problem can be expected only through a detailed, long term investigation of the fundamental factors which cause these insect outbreaks. Along with this ob-

jective should go the attack upon development of practical measures for dealing with such undesirable factors of the situation as can be controlled. In a problem as complex as this one, it cannot be expected that any single all-inclusive method which will work successfully under all conditions and in all locations is possible. These are considerations to be taken into account in the planning and development of a sustained comprehensive program of research.

Essential to this proposed program are adequate facilities for research and experimentation. Fortunately these have been made available to the extent of providing for a more adequate program than has previously been possible. The central laboratory will continue at the University of California, in quarters maintained by the State. In addition, two field laboratories are being developed by the Bureau of Entomology and Plant Quarantine where it will be possible to carry on studies and experiments tested by actual conditions in the forest. One of these laboratories, at Hat Creek in Shasta County, will serve as a center of work for northern California. The other, at Miami in Madera County, will serve the central Sierra region and southern California. A temporary field laboratory was constructed at Hackamore, Modoc County, in 1936 for a special biological project. Temporary field camps serve as facilities for special studies. Following are the more important projects which are now being developed with these facilities and with increased technical assistance.

1. Hazard Inventory of the Pine Areas.

By means of this study it is proposed to outline and map those areas which, because of forest type and environmental conditions,

are subject to recurrent barkbeetle epidemics. It is the purpose of this project to establish the basis (1) for organization and intensity of future forest insect surveys, (2) for analysis of the possibilities of sustained yield management in the light of potential insect-caused losses, (3) for advice as to the need for immediate logging or salvage of infested areas, and (4) for recommendations as to direct control of infestations in reserve areas.

Up to the close of the 1937 season, the following progress has been made on this project.

Methods of field work for rating hazard for the eastside ponderosa pine type were developed in 1936 and during the 1937 season were applied to 563,000 acres in Lassen County. This area included one complete logging working circle supplying two large mills.

A survey, analysis and recommendations were made on a tract of 26,000 acres for which private operators requested advance information for decisions as to logging plans.

Plans are being laid for extending the hazard survey to over three million acres of eastside pine type in California not yet covered.

2. Determination of Tree Susceptibility and Salvage Experiments.

Biological studies of the pine flathead have shown that the work of this insect may persist for several years in living trees before they are finally killed either by flatheads or the western pine beetle. Indications of the weakening effect of this advance can be detected by foliage and crown characters and it has further been shown that these susceptible trees can be selected and logged in advance of final killing so as to yield sound, merchantable lumber.

A fairly large scale experiment to test the practicability of this method of salvage logging and its effect in improving the general level of resistance of trees left in selectively logged stands was initiated in 1937 in cooperation with the California Forest and Range Experiment Station. This is located on the Black's Mountain Experimental Forest in Lassen County, and is scheduled to run for a period of ten years. During the season, the susceptibility of 18,712 trees was determined. Over 600,000 b.m. were selectively logged from 249 acres to remove high risk trees from the stand. The results of this work which will help to improve stand conditions, will be checked by repeated future examinations.

Over 4000 trees have been marked according to susceptibility classes on permanent sample plots outside of logging areas. As a

further test of the susceptibility theory, these will be followed for a number of years to determine if and when these trees die.

In the spring of 1937 a total of 678 green trees were selected on a logging area as showing indications of flathead infestation in the crowns and were therefore classed as susceptible. Examination of these trees after they had been felled, demonstrated that the preliminary diagnosis was 80 percent correct.

3. Biology and Control of Economic Forest Insect Species of the Region.

During the past few years, discovery of basic biological information has materially broadened our understanding of the barkbeetle problem and opened the way to new and promising lines of attack upon its solution. This applies especially to the uncovering of the role of the pine flathead in the overmature ponderosa pine stands in northern California where the heaviest losses of the region have occurred. The study of this and other important species will be pressed as profitable lines of research are opened up, and as fast as the station resources permit. This is the type of work for which the field laboratories will be most useful. The two new field centers will be equipped for biological work in the spring of 1938, and facilities for more rapid progress in these investigations will then become available.

Seasonal history, habits and host relationships:- Projects dealing with the pine flathead and the mountain pine beetle in sugar pine are already well along toward completion. Studies dealing with other species which kill trees by attacking the live cambium area, such as Dendroctonus and engraver beetles, will be initiated. Preliminary work on the relationships of these insects in their attack upon trees has shown that this is a highly important phase of the problem. Epidemic infestations are often composed of a mixture of insect species and it has been found that the relations of species in the tree and the timing of their attacks are clues to the status of the epidemic cycle. This discovery has made possible preliminary forecasting of epidemic trends for certain areas.

Defoliators now under study are the lodgepole pine needleminer and the fir tussock moth. A study has recently been initiated to determine the effect of injury due to the feeding of scale and other sucking insects which attack forest trees. A scale insect, (Matsucoccus sp) attacking ponderosa pine in Arizona, is now being studied to determine its relation to a type of injury known as "flagging".

Development of direct methods of control:- This phase of the program is concerned with the development and testing of new methods and improvements in efficiency and costs of methods now in use. It is a field of research and experimentation requiring not only an

understanding of the biology and habits of the insects; a knowledge of insecticides, their adaptability to field conditions, and standard forestry practices is equally important.

Progress to date has been marked by (1) a method of control through utilization by selective logging, already mentioned, (2) development of toxic oil formulae which are effective on barkbeetle broods in thin barked trees, and (3) development of an oil spray showing promise for control of the lodgepole needleminer in the egg and young larval stages.

Experiments have also been started to test the injection of toxic chemicals into the sap stream of trees infested with the early stages of pine flathead larvae as a measure for preventing deterioration of the wood for future logging. Plans have been made for an experimental project in Modoc County to test the control of the mountain pine beetle in young ponderosa pine stands by thinning out the competing white fir species which is considered to be responsible for the susceptible condition of these second growth forests.

Biological control of barkbeetles:- The role of predators, mainly insects, which prey upon the more important barkbeetle species, is a phase of natural control which up to the present time has been given very inadequate study. Plans have been made to study this factor intensively both in the field and in the laboratory. Attention at the present time is being centered upon two beetle predators which have been found to be the most numerous natural enemies of the mountain pine beetle under natural conditions. Field studies will be concerned with when, where, and under what conditions the predators are effective in reducing barkbeetle populations.

The laboratory work for this program will explore the possibilities of rearing predatory insects under controlled conditions and their liberation in the woods in sufficient numbers to become a factor in natural control. So far as the preliminary work has gone, the prospect for insectary production of one species of predator (Temnochila virescens) is sufficiently promising to warrant continued experimentation. The 1937 experiments have indicated that fly larvae of a species which can easily be made avaliable in quantity through laboratory cultures, are an adaptable substitute for the barkbeetle broods which are the natural food of the predator. This technique, if successful, will simplify the problem of a constant available food supply for the predator in the insectary. The ultimate possibilities of this method in biological control will depend, however, upon a complete knowledge of the behavior and adaptions of the predators under both artificial and natural conditions - a field in which much basic research is still needed.

SUPPLEMENTAL AND STATISTICAL MATERIAL

OTHER IMPORTANT INSECT INFESTATIONS OF THE 1937 SEASON

General conditions reflecting activities of the Dendroctonus species and the pine flathead, Melanophila sp., have been discussed in the main section of this report. Other insect infestations worthy of note are included in the following paragraphs.

Barkbeetles.

The pine engraver beetles (Ips spp.):- In the eastside areas of the Lassen and Modoc National Forests, an analysis of the barkbeetle populations which killed ponderosa pines indicated that in about 5 percent of the infested trees the attack had been initiated in the tops by Ips oregoni during the 1937 season. Compared with the 1936 season when 15 percent of the infested trees were first attacked by this species, a definite decline in the activity of the engraver beetles is indicated.

Late in the fall of 1937, groups of ponderosa pines were topkilled in the lower elevations of the Sierras by Ips confusus. These groups, consisting of 10 to 15 trees, were widely scattered and although an increase of activity of this species over that of the preceding season is indicated, the outbreak has not yet developed to epidemic proportions. The western pine beetle filled in the green bases of the greater part of these topkilled trees.

The fir engraver beetle (Scolytus ventralis Lec.):- Infestations in eastside type timber stands continued aggressively during 1937. Losses in white fir on the Shasta, Modoc, Lassen and Plumas over the past 5-year period have been found as a result of hazard inventory surveys and general observation to vary between 25 and 40 percent of the fir stand. In the area of 400,000 acres covered by the 1937 hazard inventory survey in the eastern part of the Lassen, the average loss, considering dead trees only, was found to be 37.6 percent. This figure does not include extensive topkilling and trunk injury caused by partial attacks.

This is in contrast to the conditions found on the westside, particularly the Eldorado, Stanislaus and Sierra where the bulk of damage to fir was confined to topkilling and partial trunk injury. The number of dead trees killed during 1937 was noticeably small, indicating a decided endemic condition which has persisted since

1934. Heavy losses in this general area occurred in 1928-29, 1931 and 1933.

Defoliators.

The fir tussock moth (Hemerocampa oslari Barnes):- For the third successive season, white fir stands in the North Warner section of the Modoc were defoliated by the caterpillars of this insect. So far, this outbreak has shown few indications of decline and it is expected that an appreciable percentage of white fir will be killed in some areas as a result of this defoliation.

Another outbreak of the same species was discovered on the eastern slopes of the southern Sierra Nevada Mountains in the summer of 1936. The heaviest centers were found between Mono Lake and Mammoth. The infestation continued during the 1937 season and has already resulted in the killing of about 15 percent of the fir in local areas. So far the outbreak has not invaded any of the intensively used summer home tracts and no measures have been taken to protect the trees by spray control. Prevalence of a wilt disease observed during 1937 indicates that there is a possibility that this epidemic may be about ready to decline.

Both of the above outbreaks are of considerable interest in that the last authentic record of a defoliating epidemic of this species within the region occurred in 1906-7, some thirty years ago. At that time, tussock moth, presumably the same species, was prevalent on the western slopes of the Sierra Nevadas and caused noticeable defoliation of the white fir.

The lodgepole needleminer (Recurvaria milleri, Busck.):- This insect continued its invasion of the lodgepole pine stands of the Tuolumne watershed in the Yosemite National Park. Since the present epidemic started in 1931, it has spread into the Merced drainage and is apparently gaining a foothold there. The severity of recent defoliations in Rodgers Canyon and Forsyth Pass is rapidly bringing about the formation of new "ghost forests". However, in the Porcupine Flat center, mentioned in the report of last year, it was found that the infestation was dying down apparently as a result of heavy parasitism. Control experiments were again carried on by the Berkeley Laboratory, and a thorough check made on all phases of the life history of the insect with a view to developing the best timing for application of sprays. Several light oil formulae used against the egg and early larval stages show considerable promise for the protection of trees on camp grounds and road screens.

The Great Basin tent caterpillar (Malacosoma fragilis Streck):- During June 1937, the Forest Service reported heavy defoliation of bitter brush was causing injury to grazing ranges east of the Sierras in the Mono and Inyo Forests. An investigation showed that this was caused by the great basin tent caterpillar. An area of

about 20,000 acres was defoliated this season. This insect apparently prefers the bitter brush (Purshia tridentata) which is one of the main grazing resources in these eastside ranges. An appreciable number of plants had been killed as a result of this, and old defoliations which occurred about six years ago.

The alder leaf beetle (Haltica bimarginata Say):- In the southern Sierras and the San Bernardino mountains, 1937 was an off year for this insect. Repeated defoliations of alders growing in the canyons have been common in past seasons and have caused considerable complaint on the part of users of public camp grounds and summer home owners. The actual injury to the trees, however, has been only temporary as recovery from the effects of these sporadic outbreaks can be expected for practically all trees growing in favorable sites. The problem arising from these infestations is largely that of the nuisance created in intensively used areas due to loss of shade and the debris created by the caterpillars.

On the other hand this insect was active in some of the northern California areas, notably in Tehama County, where fairly severe defoliations were noted.

SUMMARY OF CONDITIONS - 1937
EASTSIDE PINE AREAS - NORTHEASTERN CALIFORNIA

	Modoc National Forest	Shasta National Forest	Lassen National Forest	Plumas National Forest
Area surveyed	Happy Camp	Fall River Mills	Eastern Lassen	Eastern Plumas
Infestation history (See page 19)	Figure 2	Figure 3	Figure 4	Figure 5
Acres sampled	305,799	138,700	315,830	81,160
Estimated loss (Bd.ft.)	24,316,000	5,410,000	18,200,000	7,150,000
General condition	Heavy endemic	Endemic	Endemic	Heavy endemic
Ponderosa loss	Moderate	Low	Low	Low
Jeffrey loss	Few trees	None	Rising	Fairly high
Lodgepole loss	None	None	Rising	Rising
White fir loss	Light	Moderate	Heavy	Moderate
Areas needing coverage Previously surveyed	Warner Mts.	Burney Flat Weed Cutover	Willard Chance	Little Last Chance
Previously unsurveyed	Happy Camp Cut-over Crowder Flat Adin Mts. Hayden Hill Big Valley Mts.	McCloud Cutover Harris Mtn. Big Bend Goose Nest Dist.	Hat Creek Hatchet Mtn. West Side	Not yet selected

Special attention, during 1938, will be given to:

1. Reconnaissance of lodgepole areas in which the infestation tendency is upward. This includes the Lassen National Park and parts of the Shasta National Forest.
2. Extension of the plot survey system through parts of the Lassen, southeastern Shasta and Modoc forests following work by the Hazard Inventory Project.

PINE LOSSES IN NORTHEASTERN CALIFORNIA

ESTIMATES AND PLOT SURVEY AVERAGES

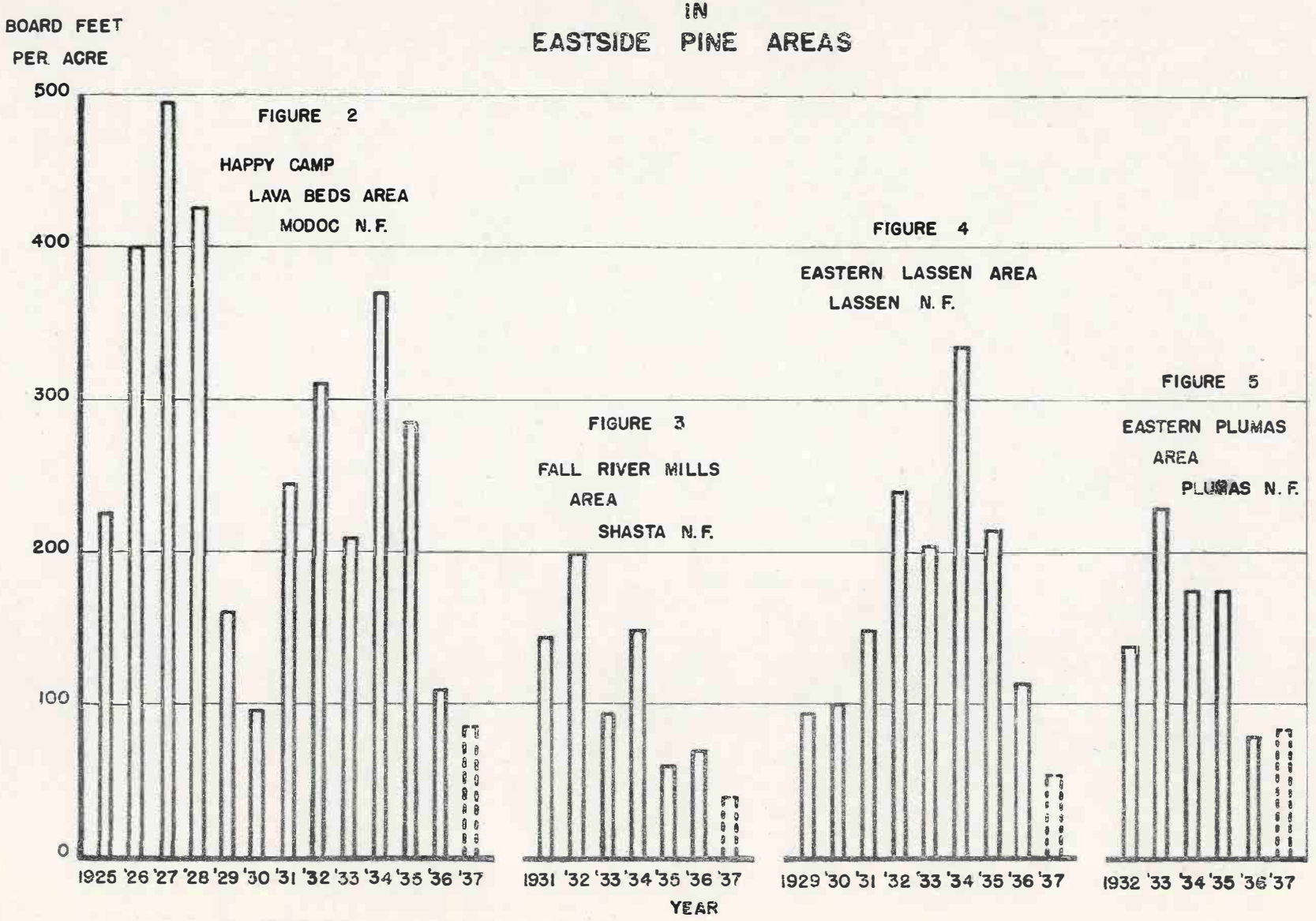
Year	Estimate of Pine Loss in State. Board Feet	Plot Survey Averages - Board Feet per Acre			
		Happy Camp Lava Beds	Eastern Lassen Area	Eastern Plumas Area	Fall River Mills Unit
1925	750,000,000	226			
1926	1,000,000,000	402			
1927	1,200,000,000	495			
1928	900,000,000	427			
1929	600,000,000	162	95		
1930	500,000,000	97	98		
1931	1,250,000,000	246	150		146
1932	1,500,000,000	311	241	140	198
1933	800,000,000	212	203	231	95
1934	750,000,000	370	335	177	150
1935	700,000,000	283	214	174	59
1936	500,000,000	112	113	82	68
*1937	350,000,000	87	56	84	39
Totals	10,800,000,000 13 yrs.	3,430 13 yrs.	1,505 9 yrs.	888 6 yrs.	755 7 yrs.

830

* 1937 figures are estimates based on incomplete cruises.

Average annual 830,000,000.

INFESTATION TRENDS IN EASTSIDE PINE AREAS



J. H. FISKE

SELECTIVE LOGGING PROJECT - BLACK'S MOUNTAIN EXPERIMENTAL FOREST
IN COOPERATION WITH
THE CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

SUMMARY OF PROGRESS - 1937.

LOCATION:

Bogard Ranger District, Lassen National Forest.
Township 33 N, Ranges 7 and 8 E, Mount Diablo Base and Meridian.

AREA:

Total timbered area	9,825.7 acres
Trees over 12" classified on	913.5 acres
Susceptible trees cut on	240.0 acres
Area remaining to be classified	8,912.2 acres

STAND:

Total stand	167,906	m.b.m.
Stand Classified	16,057	m.b.m.
Susceptible volume cut	625	m.b.m.
Stand remaining to be classified	151,749	m.b.m.

SUSCEPTIBILITY CONDITIONS IN STAND ON 913.5 ACRES:

Susceptibility Class	% of Trees	% of Volume
Total stand	100.0 (18,712 trees)	100.0 (16,057 m.b.m.)
I	71.6	60.3
II	17.8	24.4
III	5.7	8.2
IV	4.9	7.1
III plus IV (Highly susceptible)	10.6 (1,992)	15.3 (2,454 m.b.m.)

FOREST INSECT HAZARD INVENTORY

SUMMARY OF PROGRESS - 1937

AREA:

Total area in eastside ponderosa pine type	3,369,000 acres
Area covered by inventory - 1937	410,000 acres
Area remaining to be inventoried	2,959,000 acres
Percent total area covered by inventory - 1937	12.2

STAND.

Total eastside pine stand	26,284,000 m.b.m.
Stand covered by inventory - 1937	4,618,000 m.b.m.
Stand remaining to be inventoried	21,666,000 m.b.m.
Percent total stand covered by inventory - 1937	17.6

SUMMARY OF RESULTS - 1937

		Hazard III	Hazard IV	Hazard V
Total timbered area	(acres)	183,400	159,200	67,200
	(percent)	45	39	16
		Per Acre Basis		
Stand, all species	(bd. ft.)	20,194	14,409	6,447
3-needle pines	(bd. ft.)	14,588	12,406	5,791
Loss, all species	(bd. ft.)	2,326	3,939	3,927
	(percent)	10	23	38
Loss, 3-needle pines	(bd. ft.)	1,717	2,986	3,820
	(percent)	11	19	40
Portion of 3-needle pine stand highly susceptible to insect attack	(bd. ft.)	2,378	3,064	1,888
	(percent)	16	25	33

PROJECT LOCATIONS
FOREST INSECT INVESTIGATIONS AND SURVEYS
CALIFORNIA REGION

BERKELEY HEADQUARTERS LABORATORY
Administration — Public Service
Special laboratory research — Supervision of field work

HACKAMORE FIELD LABORATORY

Research.

*2. Fandango Control Experiment. Thinning pine pole stands
3. Biological studies. Flathead borer life history
Relation of flathead borers and tree susceptibility
Tree mediation to preserve values of infested trees
Effects of low temperatures in infestations
Relation of primary species in infested pines

Surveys.

1. Buck Creek. Sampling North Warner infestations
4. North Shasta. Loss record on 125,000 acres cutover lands
5. Medicine Lake. Control to protect aesthetic values
6. Modoc surveys. 15 plots sampling 310,000 acres

HAT CREEK FIELD LABORATORY

Research.

8. Biological studies. Insects affecting reproduction
9. Black's Mountain. Cultural control experiments
Stand susceptibility to barkbeetle attacks
Effects of topkilling on tree susceptibility
Relations of primary insects in infested pines

Surveys.

7. Fall River Unit. 5 plots sampling 139,000 acres
10. Hazard Inventory. Rating hazard from insects. 563,000 acres sampled in 1937
11. Eastern Lassen. 12 plots sampling 315,000 acres virgin timber. 5 plots sampling cutover areas
12. Volcanic National Park. Protection of park stands of high value
13. Eastern Plumas. Sampling 81,000 acres commercial timber

MIAMI FIELD LABORATORY

Research.

14. Institute of Forest Genetics. Control in plantations
15. Biological studies. Mountain pine beetle life history
Predators of mountain pine beetle
Host relations and biological strains of barkbeetles
Control of lodgepole needleminer

Surveys.

15. Yosemite lodgepole. Occurrence and damage by needleminer
16. Stanislaus forests. Sampling 296,000 acres pine stands
17. Mono and Inyo. Insects killing fir and forage plants
18. Sierra pine forests. Loss records for 72,000 acres
20. King's River. Pine losses sampled for 14,500 acres

SOUTHERN CALIFORNIA

Surveys.

Cooperation with private individuals, civic bodies, state and national agencies in protecting high aesthetic values by the surveys and control in the following areas.

21. Mineral King
22. Camp Nelson and Camp Wishon
23. Mount Pinos
24. Figueroa Mountain
25. Arrowhead Lake
26. Big Bear Lake
27. Idyllwild and San Jacinto
28. Lagunas, Cuyamaca State Park

ARIZONA FIELD LABORATORY

Research.

Life history, host relations and control of Matsucoccus sp.

Surveys.

Occurrence and intensity of Matsucoccus infestations

* Numbers refer to project locations given on accompanying map.

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

PROJECT LOCATIONS

FOREST INSECT INVESTIGATIONS AND SURVEYS

CALIFORNIA REGION

SCALE OF MILES

0 20 40 60 80 100

LEGEND

FOR PROJECT DESCRIPTIONS SEE OPPOSITE PAGE

FOREST TYPE

(34) PRIMARY SURVEY AREAS OR LARGE SCALE CONTROL RESEARCH PROJECTS

(34) SECONDARY SURVEY AREAS OR DETAILED BIOLOGICAL AND CONTROL RESEARCH PROJECTS